Metastasis de Melanoma al Cerebro tratado con Radiacion Estereotactic usando VMAT - RapidArc

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14vo Curso de Educacion Continua
Sociedad de Fisica Medica de Nuevo Leon
Monterrey – Mexico 2012

趙 CHAO FAMILY COMPREHENSIVE CANCER CENTER
UNIVERSITY of CALIFORNIA · IRVINE

UC Irvine Varian Trilogy System usado para tratamientos de VMAT - RapidArc

Caso Clinico:

Melanoma con Metastasis al Cerebro

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Presentacion de Caso Clinico

- Paciente (M) de 67 anhos diagnosticado con melanoma metastatica al cerebro – Estado IV (Stage IV).

- Historia Clinica:
  Excision de una masa melanomatica en el brazo izquierdo al nivel del hombro seguido por excision de nodos sentinel axillares

  Un anho despues, reseccion de tumor cerebral localizado en la zona frontoparietal derecho seguido con radioterapia estereotactica (SRS) con GammaKnife (18 Gy).

  MRI exploratorio (2 meses despues de SRS) revela un nuevo tumor cerebral en el lobulo occipital izquierdo. Excision del tumor seguido por SRS con GammaKnife (18 Gy).

  15 meses despues de la segunda excision, MRI revela 4 nuevo tumores cerebrales. Paciente para ser tratado con LINAC SRS

Presentacion de Caso Clinico - continuacion

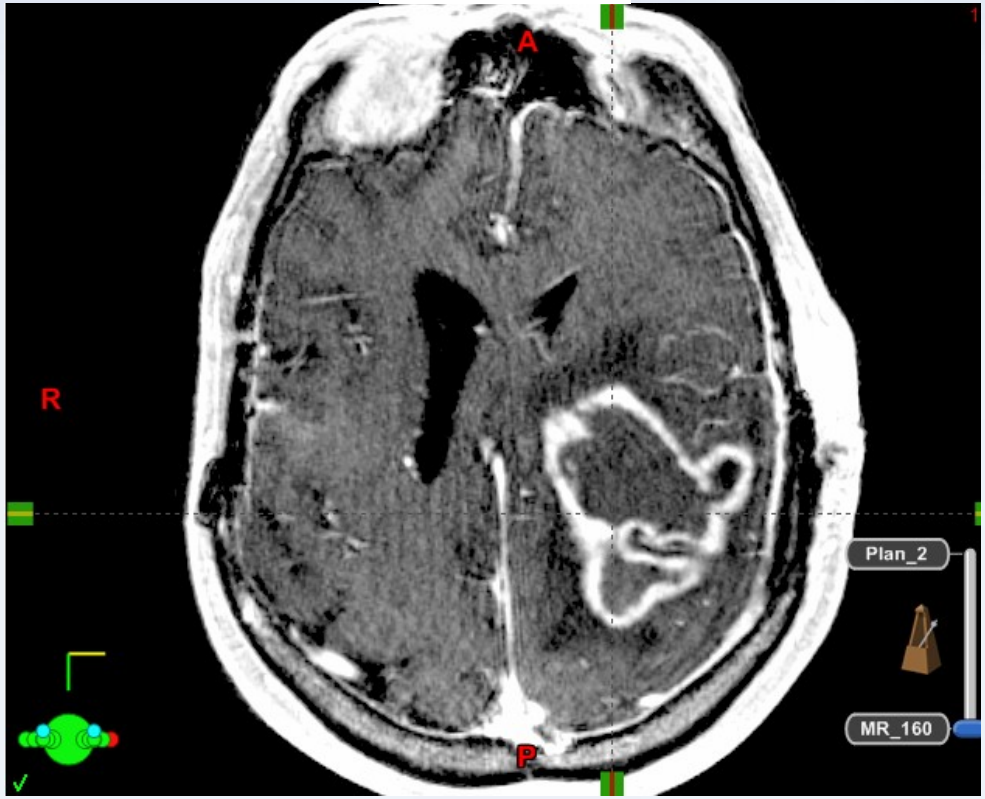
- Otra Historia Medica:
  - Significativa para Melanoma

- Historia Social:
  - Electricista retirado
  - No Fuma
  - No Alcohol

Tratamiento con Radiacion

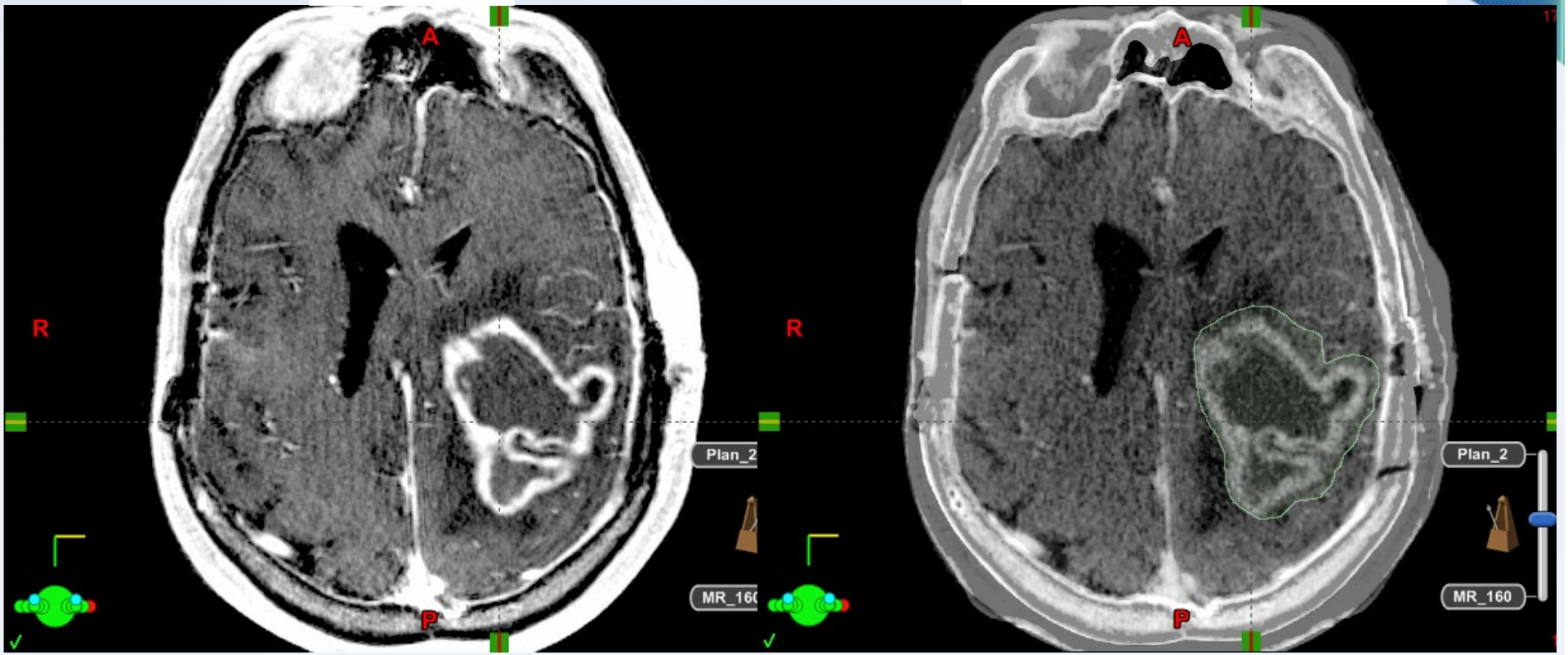
- Dosis Total = 24 Gy en 6 Gy / fraccion.
- Numero de Tumores Tratados = **4**
- Tecnica de Tratamiento = VMAT – RapidArc
  2-arcos: axial de 358 grados; Collimador: 45º, 315º
- Organos de Riesgo delineados: Cerebro, Tronco Encefalico, Chiasma Optico
- Immobilizacion: Mascara Cranial

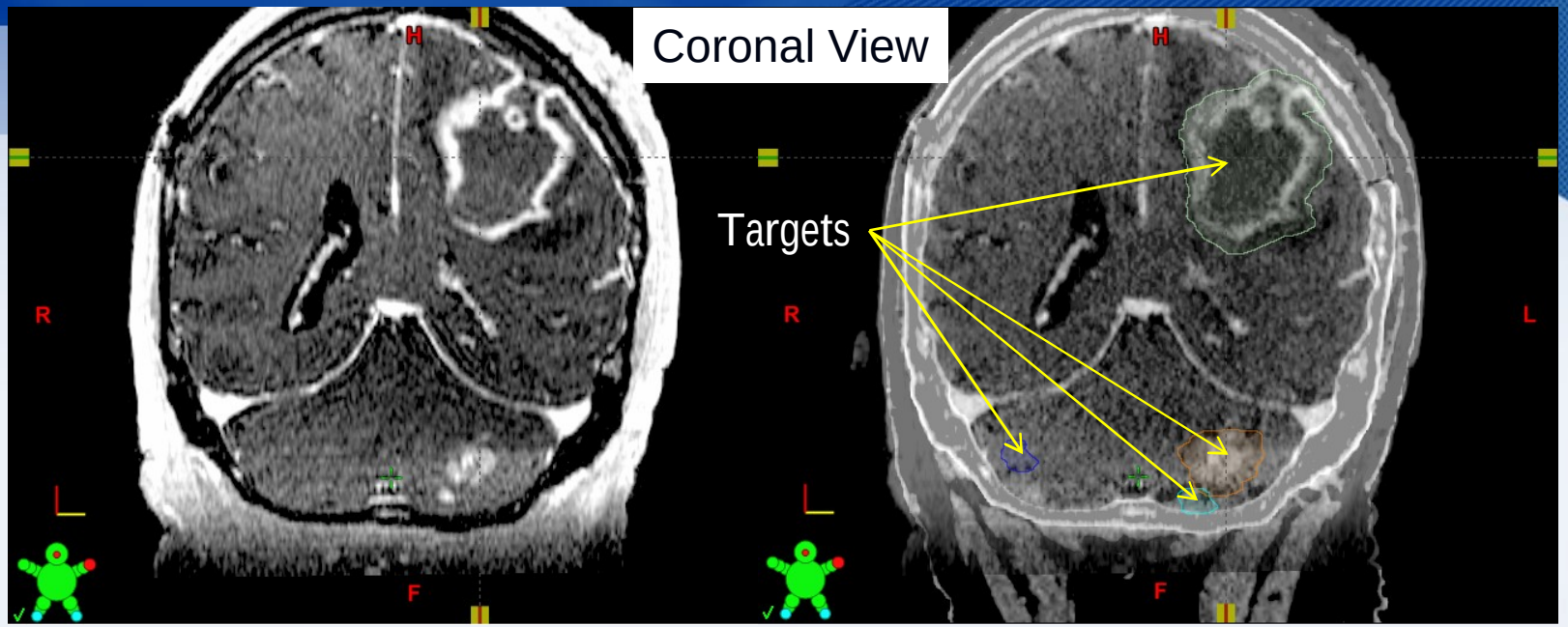
MRI Scan

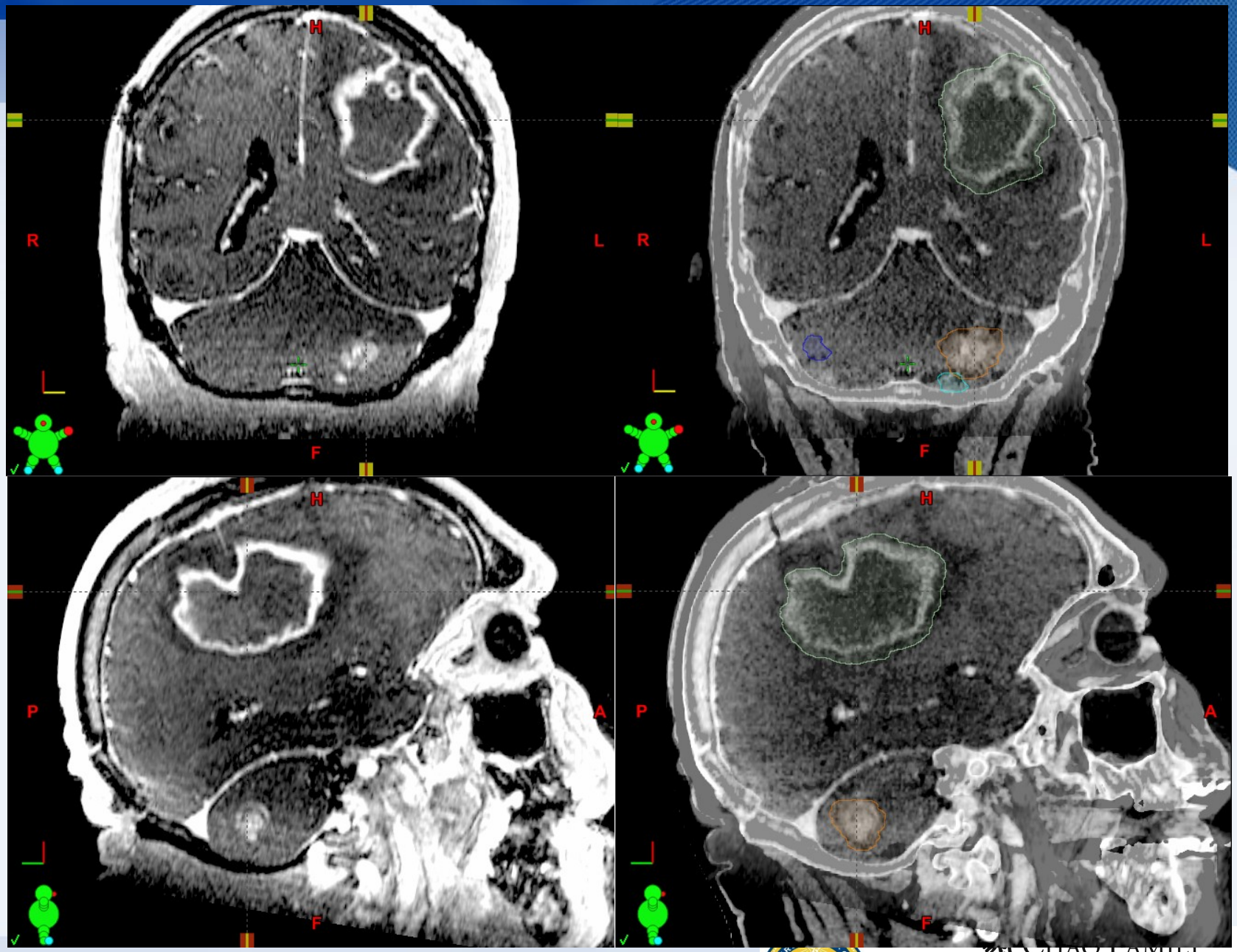


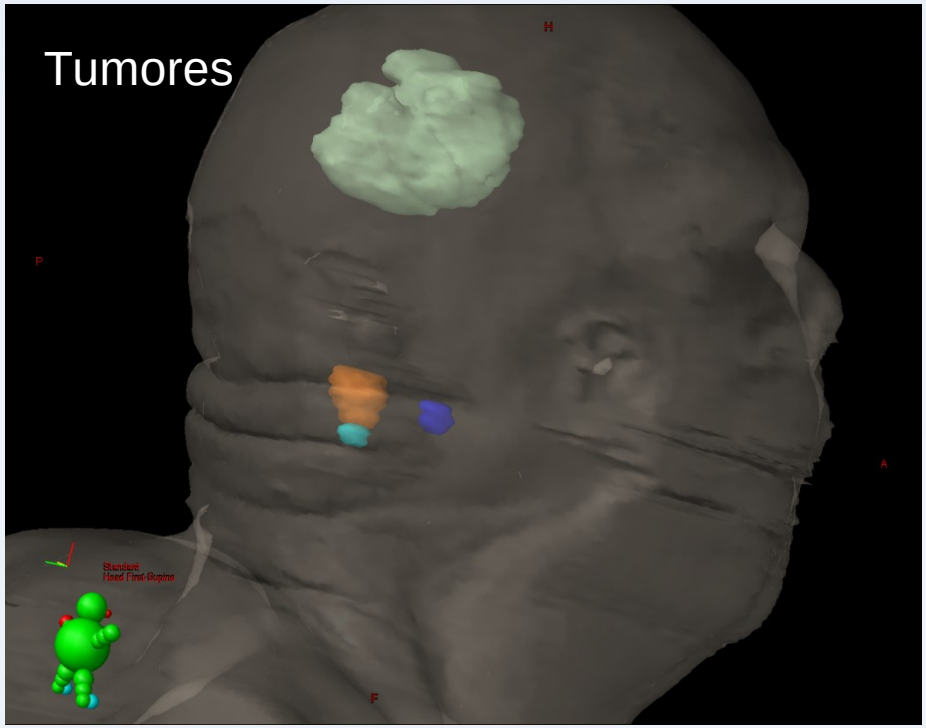
MRI Scan

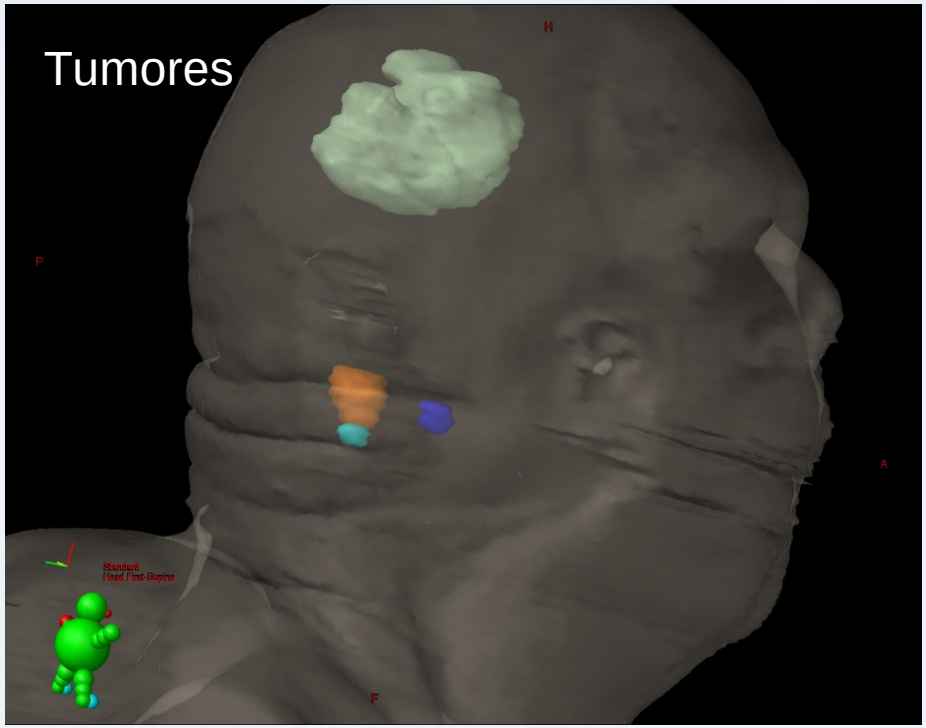
MRI fused to Planning CT
One TGT contoured

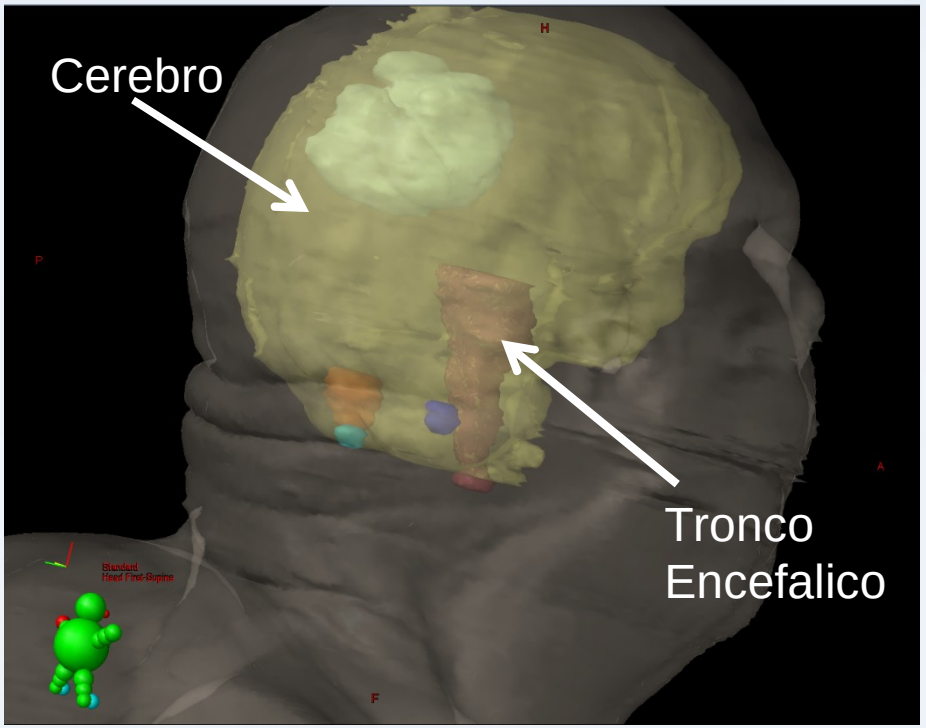


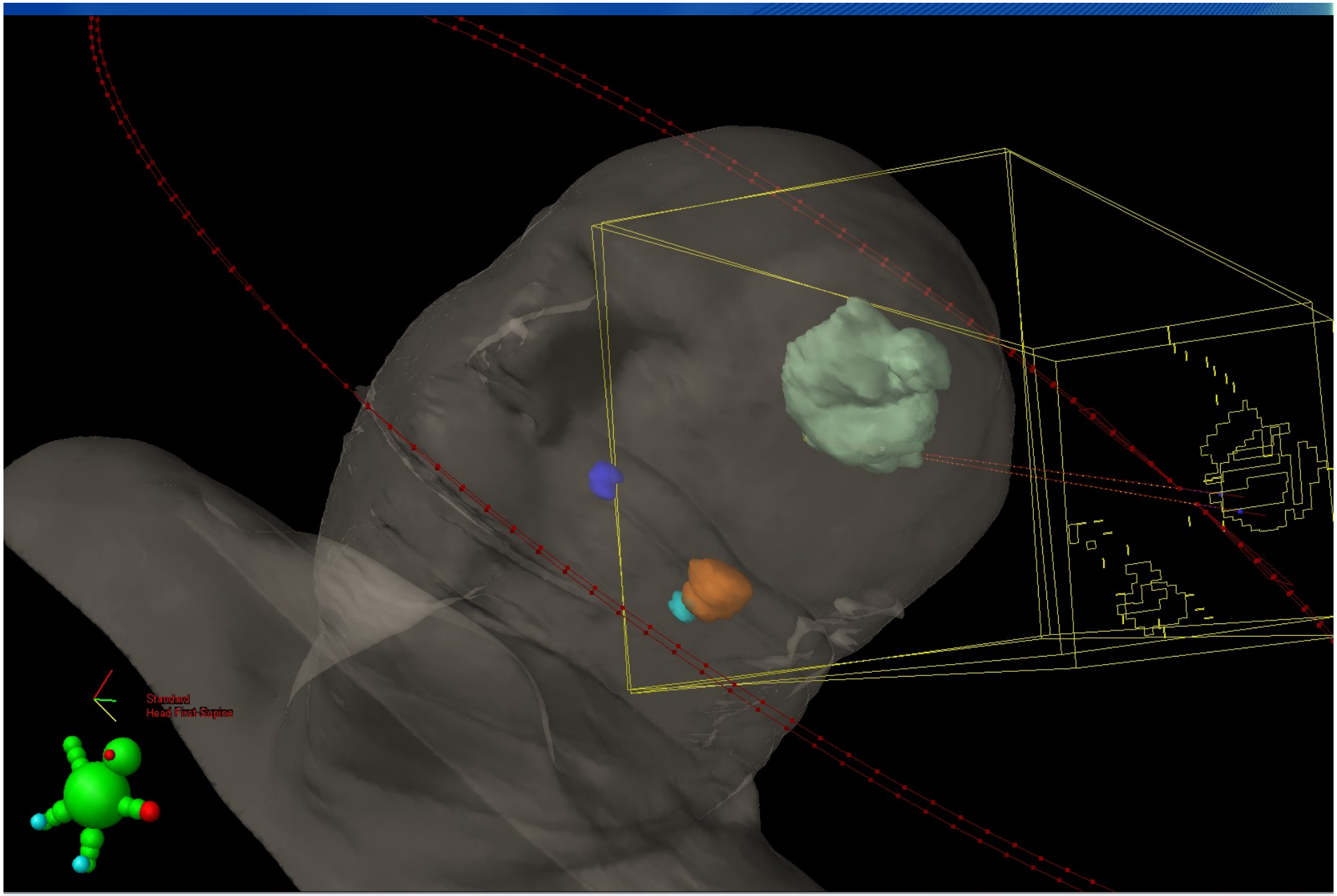

Coronal View
Targets
H
R
F
H
R
L
F

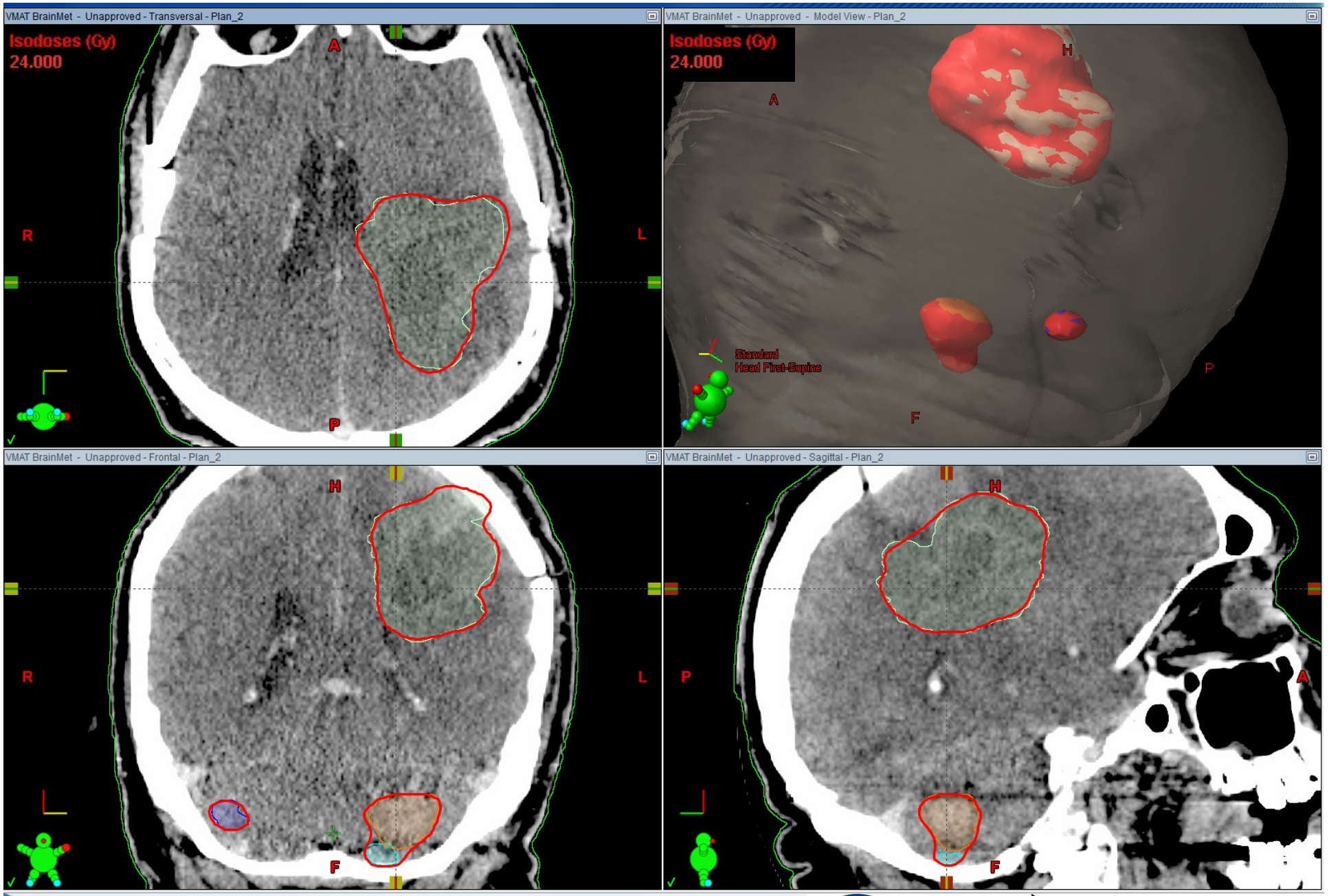

H
R
L
F
H
L R
L
F
H
P
A
F
H
P
A
F

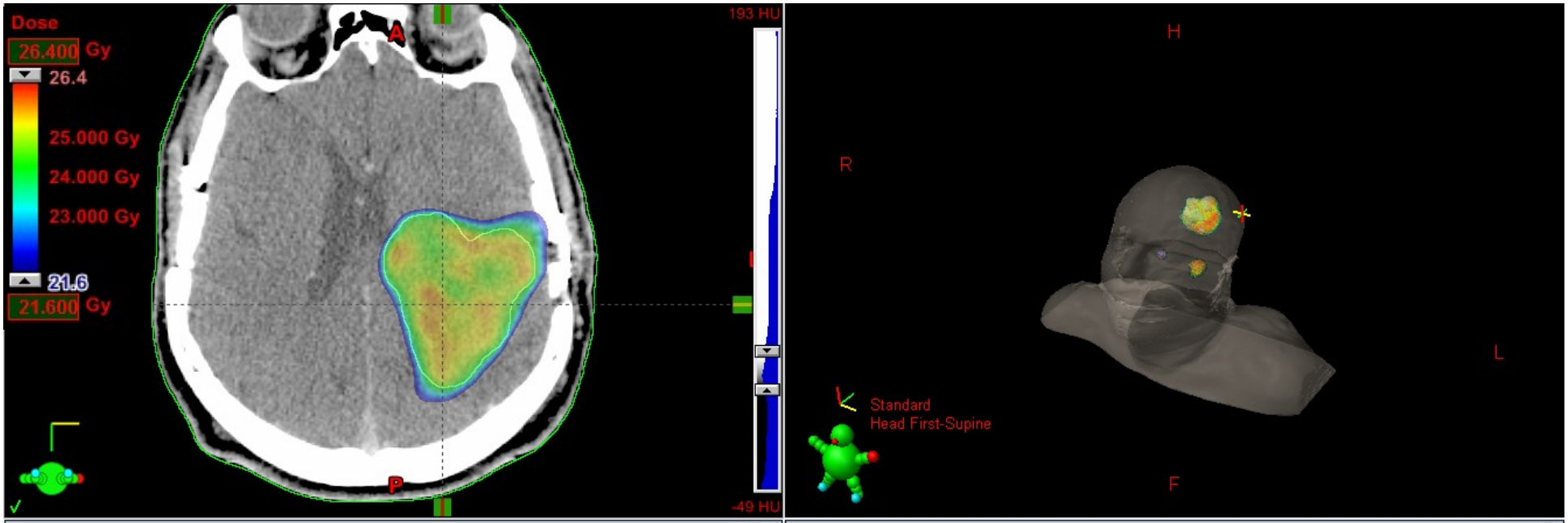

Tumores
H
P
A
F
Standard
Head First-Supine

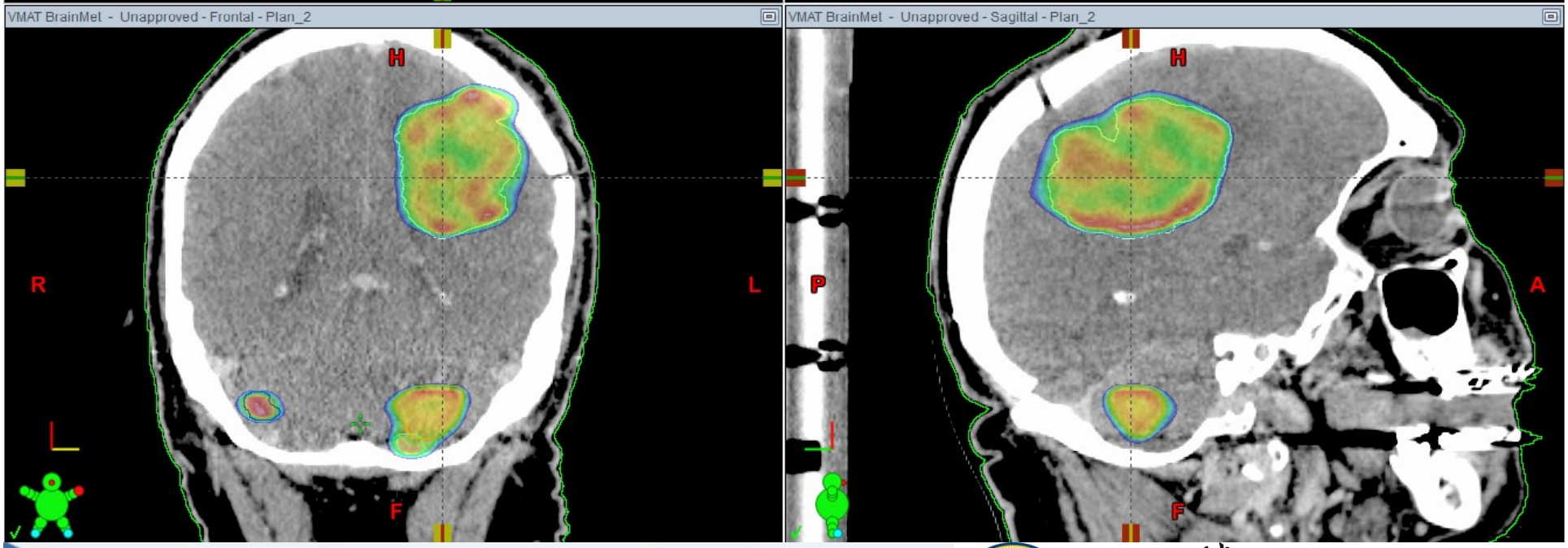

Tumores

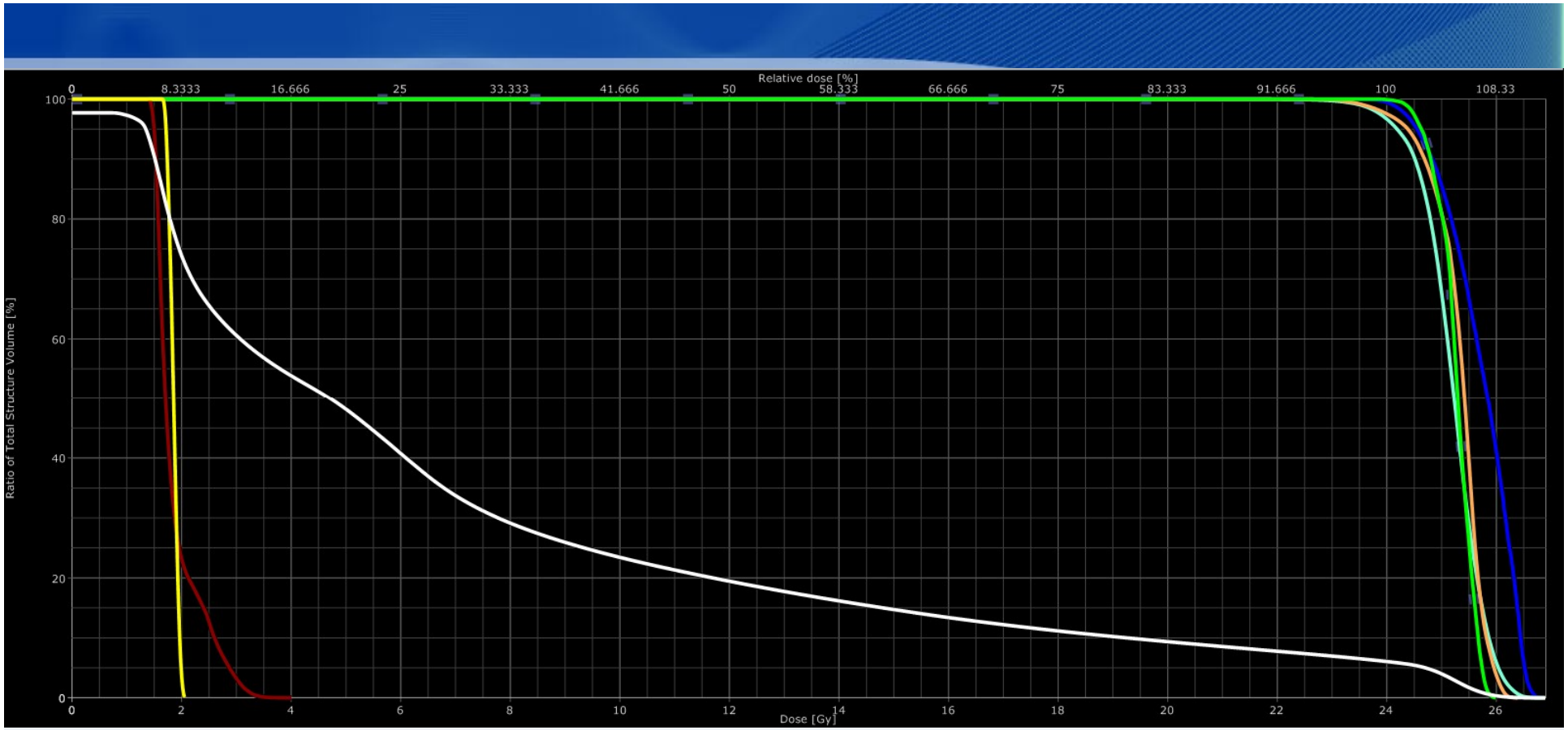

Cerebro
Tronco
Encefalico


Standard
Head First-Supine


VMAT BrainMet - Unapproved - Transversal - Plan_2
Isodoses (Gy)
24.000
A
R
L
P
VMAT BrainMet - Unapproved - Model View - Plan_2
Isodoses (Gy)
24.000
H
A
Standard
Head First-Supine
P
F
VMAT BrainMet - Unapproved - Frontal - Plan_2
H
R
L
F
VMAT BrainMet - Unapproved - Sagittal - Plan_2
H
P
A
F


Dose
26.400 Gy
26.4
25.000 Gy
24.000 Gy
23.000 Gy
21.6
21.600 Gy
193 HU
-49 HU
A
P
H
R
L
F
Standard
Head First-Supine

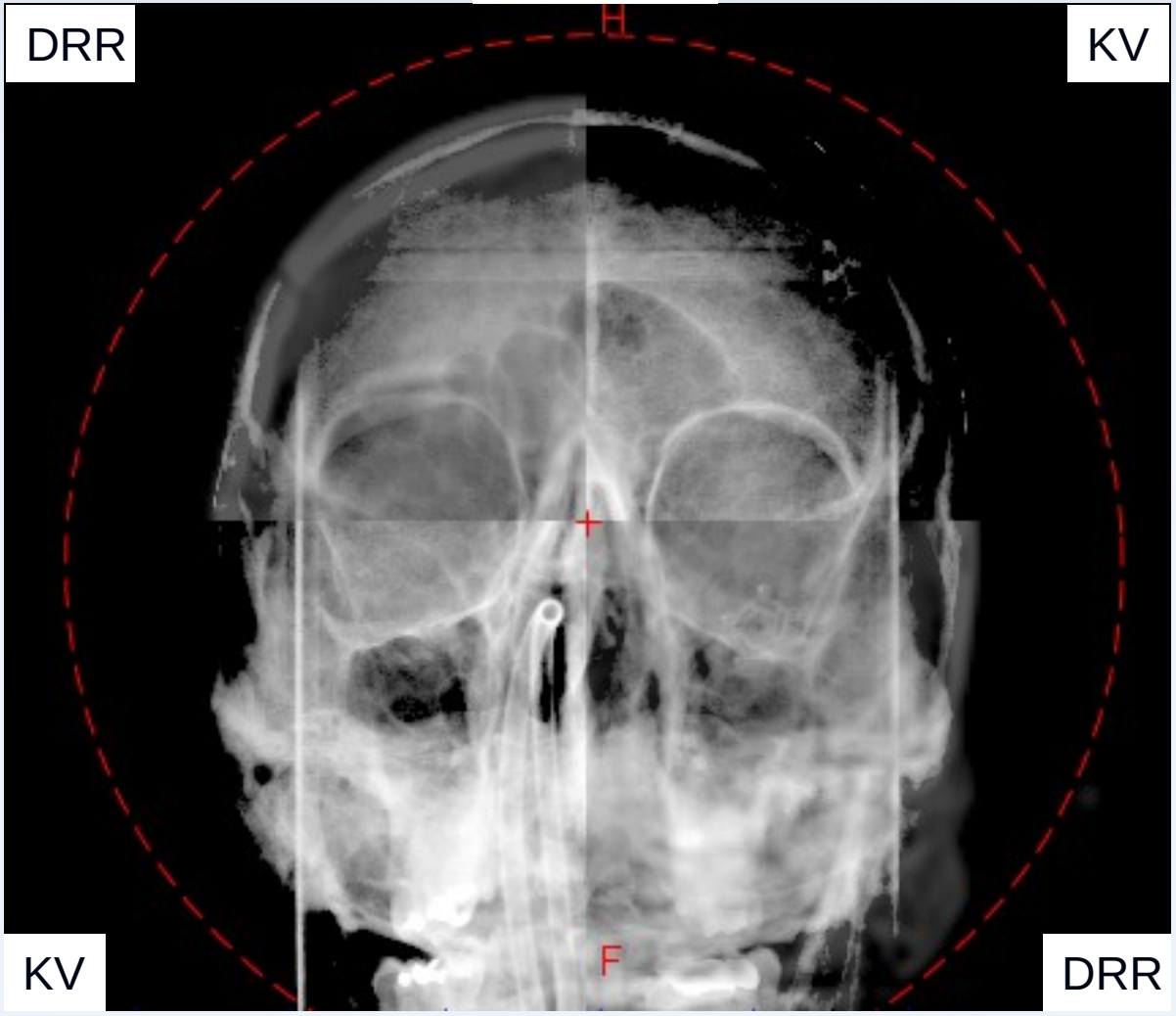

VMAT BrainMet - Unapproved - Frontal - Plan_2
VMAT BrainMet - Unapproved - Sagittal - Plan_2
H
R
L
F
P
A



Structure	Structure Status	Coverage [%/%]	Volume	Min Dose	Max Dose	Mean Dose	Modal Dose	Median Dose	Std Dev
Optic_Chiasm	Approved	100.0 / 81.4	0.3 cm³	1.7 Gy	2.1 Gy	1.9 Gy	1.8 Gy	1.9 Gy	0.1 Gy
nLT_Cerebllr_inf	Approved	100.0 / 86.6	0.5 cm³	23.8 Gy	26.0 Gy	25.3 Gy	25.2 Gy	25.3 Gy	0.3 Gy
nRT_cerebellar	Approved	100.0 / 95.0	0.8 cm³	23.4 Gy	26.8 Gy	25.7 Gy	26.4 Gy	25.8 Gy	0.6 Gy
nLT_Cerebllr_sup	Approved	100.0 / 98.4	4.9 cm³	22.2 Gy	26.4 Gy	25.3 Gy	25.5 Gy	25.4 Gy	0.5 Gy
brainstem	Approved	100.0 / 97.4	25.3 cm³	1.4 Gy	4.0 Gy	1.9 Gy	1.6 Gy	1.7 Gy	0.4 Gy
nLT_Post_FrntLrg	Approved	100.0 / 99.9	77.5 cm³	20.8 Gy	26.9 Gy	25.2 Gy	25.3 Gy	25.2 Gy	0.6 Gy
Brain	Approved	97.7 / 99.5	1476.7 cm³	0.7 Gy	26.9 Gy	7.3 Gy	1.7 Gy	4.9 Gy	7.0 Gy

DRR and KV Co-Registration - IGRT

AP Image

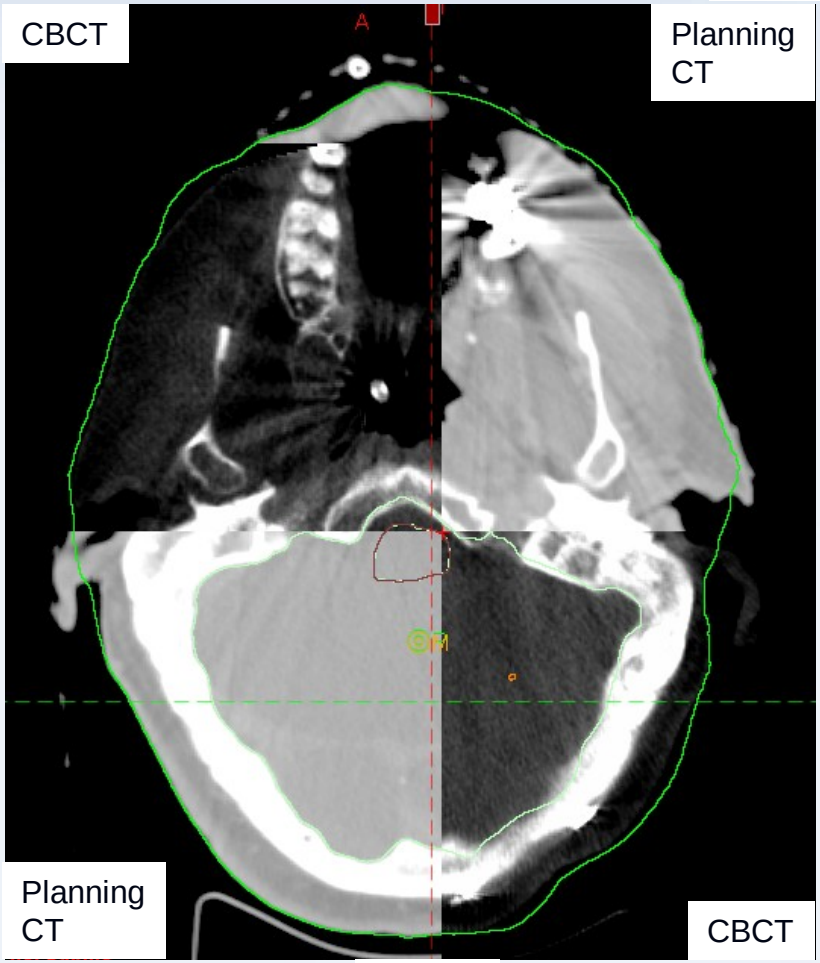


DRR and KV Co-Registration - IGRT

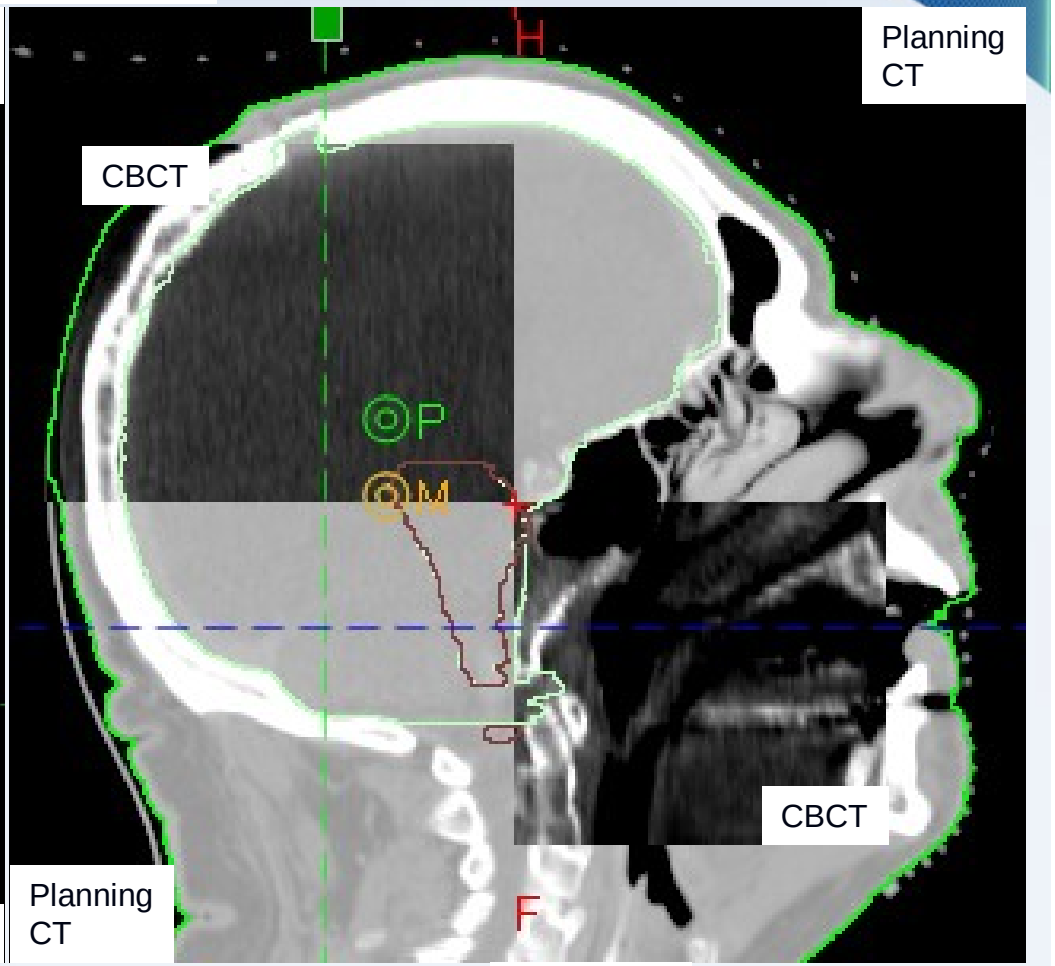
RT Lateral Image

DRR and KV Co-Registration - IGRT

CBCT Image



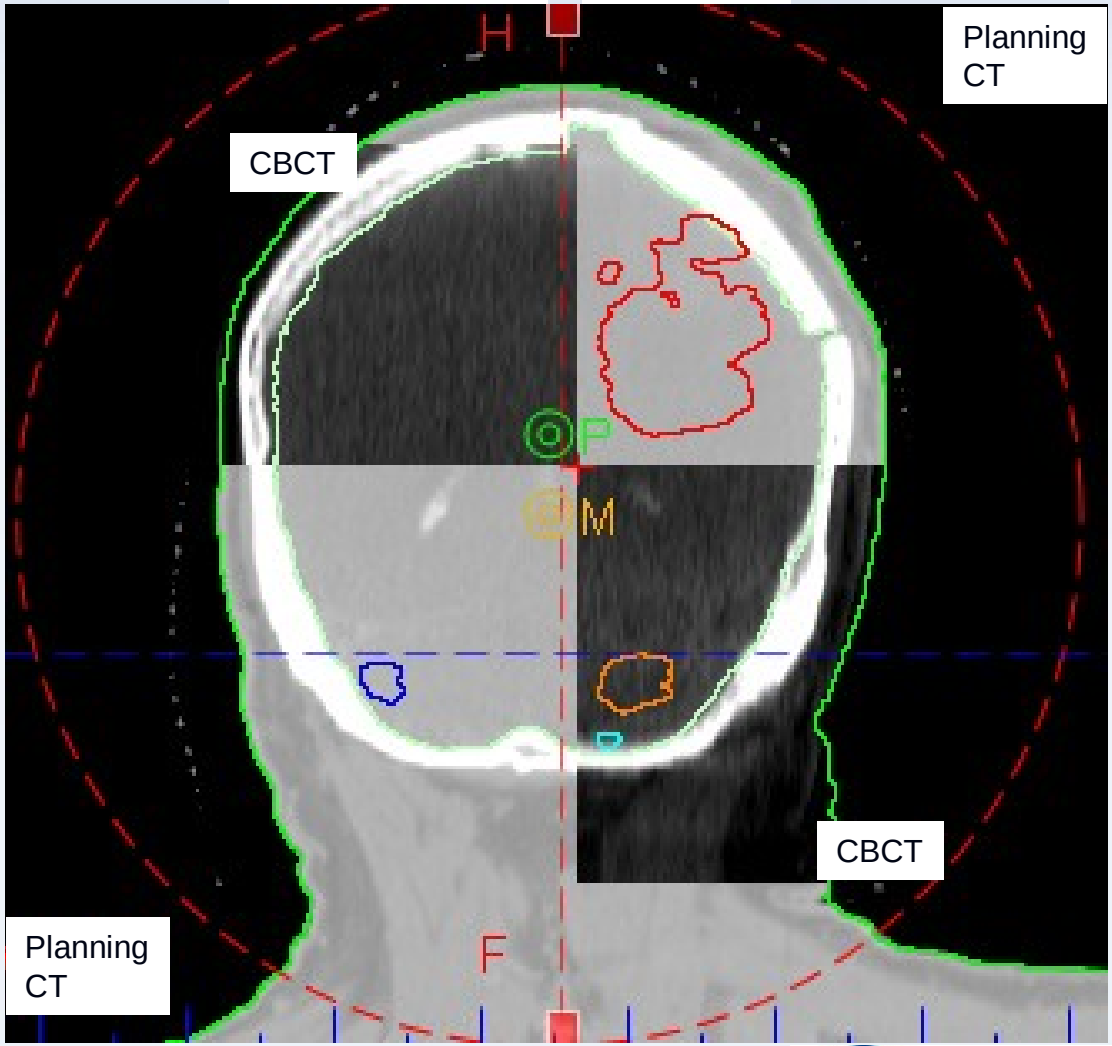
Axial



Sagittal

DRR and KV Co-Registration - IGRT

CBCT Image | Coronal



VMAT-RapidArc vs IMRT en tratamientos de SRS y SBRT

Site	Patient ID	Lesion #	PTV Vol. (cc)	Dose / Fx (Gy)	Total Dose (Gy)	CI_{RTOG}			PCI			HI_{RTOG}		
						IMRT	1-arc	2-arc	IMRT	1-arc	2-arc	IMRT	1-arc	2-arc
Brain	1	1	2.57	7.0	35.0	1.28	1.16	1.16	1.36	1.23	1.23	1.08	1.11	1.10
		2	20.48	7.0	35.0	1.77	1.46	1.41	1.85	1.61	1.54	1.10	1.18	1.17
		3	15.66	7.0	35.0	1.37	1.37	1.34	1.49	1.49	1.45	1.08	1.13	1.10
	2	4	0.5	6.0	24.0	1.94	1.82	1.84	1.94	1.82	1.84	1.07	1.09	1.08
		5	4.95	6.0	24.0	1.11	1.10	1.16	1.14	1.19	1.22	1.09	1.10	1.10
		6	77.54	6.0	24.0	1.04	1.08	1.07	1.11	1.15	1.14	1.12	1.17	1.12
		7	0.76	6.0	24.0	1.46	1.36	1.41	1.46	1.37	1.42	1.10	1.13	1.12
	3	8	6.67	5.0	25.0	1.20	1.20	1.14	1.28	1.27	1.21	1.08	1.08	1.09
Mean ± SD						**1.40 ± 0.32**	**1.32 ± 0.24**	**1.31 ± 0.25**	**1.45 ± 0.31**	**1.39 ± 0.23**	**1.38 ± 0.23**	**1.07 ± 0.01**	**1.11 ± 0.02**	**1.09 ± 0.02**
H&N	4	9	7.71	2.2	70.4	1.73	1.45	1.39	1.84	1.55	1.48	1.15	1.17	1.14
	5	10	148.85	6.0	36.0	0.97	1.01	0.98	1.20	1.25	1.20	1.22	1.23	1.22
	6	11	0.55	5.0	20.0	1.89	1.55	1.80	2.01	1.55	1.80	1.12	1.12	1.12
Mean ± SD						**1.53 ± 0.49**	**1.34 ± 0.29**	**1.39 ± 0.41**	**1.68 ± 0.43**	**1.45 ± 0.17**	**1.49 ± 0.30**	**1.13 ± 0.01**	**1.13 ± 0.04**	**1.13 ± 0.03**
Abdomen	7	12	160.49	2.5	50.0	**1.02**	**1.04**	**1.02**	**1.09**	**1.10**	**1.09**	**1.08**	**1.10**	**1.10**
Spine	8	13	6.23	16.0	16.0	1.17	1.79	1.33	1.23	1.82	1.41	1.09	1.08	1.09
	9	14	654.48	5.0	25.0	1.05	0.98	1.17	1.35	1.42	1.32	1.24	1.29	1.24
	10	15	161.54	3.5	35.0	1.08	1.21	1.14	1.15	1.29	1.21	1.17	1.18	1.16
	11	16	27.99	5.0	25.0	1.06	1.18	1.03	1.16	1.27	1.14	1.17	1.16	1.16
		17	27.23	5.0	25.0	1.07	1.09	1.05	1.18	1.20	1.16	1.18	1.16	1.17
	12	18	35.6	5.0	25.0	0.95	0.91	0.89	1.06	1.00	0.99	1.11	1.10	1.09
		19	31.69	5.0	25.0	0.95	0.87	0.85	1.06	1.02	1.01	1.13	1.11	1.10
Mean ± SD						**1.05 ± 0.08**	**1.15 ± 0.31**	**1.06 ± 0.17**	**1.17 ± 0.10**	**1.29 ± 0.28**	**1.18 ± 0.15**	**1.15 ± 0.05**	**1.17 ± 0.06**	**1.15 ± 0.04**
Pelvis	13	20	181.98	1.8	5.4	1.12	1.13	1.17	1.19	1.20	1.24	1.12	1.13	1.13
	14	21	196.8	5.0	25.0	1.01	1.04	1.03	1.07	1.10	1.10	1.09	1.09	1.10
	15	22	649.04	2.5	37.5	1.06	1.12	1.14	1.13	1.19	1.21	1.14	1.19	1.14
	16	23	88.16	3.0	30.0	1.26	1.12	1.11	1.34	1.19	1.18	1.16	1.17	1.15
Mean ± SD						**1.11 ± 0.11**	**1.10 ± 0.04**	**1.11 ± 0.06**	**1.18 ± 0.12**	**1.17 ± 0.05**	**1.18 ± 0.06**	**1.11 ± 0.04**	**1.13 ± 0.03**	**1.12 ± 0.01**
Overall Mean ± SD						**1.24 ± 0.31**	**1.22 ± 0.25**	**1.20 ± 0.25**	**1.33 ± 0.30**	**1.32 ± 0.23**	**1.29 ± 0.22**	**1.13 ± 0.05**	**1.14 ± 0.05**	**1.13 ± 0.04**

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VMAT-RapidArc vs IMRT en tratamientos de SRS y SBRT

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Brain	1	1	2.57	7.0	35.0	1.28	1.16	1.16	1.36	1.23	1.23	1.08	1.11	1.10
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	2	4	0.5	6.0	24.0	1.94	1.82	1.84	1.94	1.82	1.84	1.07	1.09	1.08
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		6	77.54	6.0	24.0	1.04	1.08	1.07	1.11	1.15	1.14	1.12	1.17	1.12
		7	0.76	6.0	24.0	1.46	1.36	1.41	1.46	1.37	1.42	1.10	1.13	1.12
	3	8	6.67	5.0	25.0	1.20	1.20	1.14	1.28	1.27	1.21	1.08	1.08	1.09
Mean ± SD						**1.40 ± 0.32**	**1.32 ± 0.24**	**1.31 ± 0.25**	**1.45 ± 0.31**	**1.39 ± 0.23**	**1.38 ± 0.23**	**1.07 ± 0.01**	**1.11 ± 0.02**	**1.09 ± 0.02**
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	5	10	148.85	6.0	36.0	0.97	1.01	0.98	1.20	1.25	1.20	1.22	1.23	1.22
	6	11	0.55	5.0	20.0	1.89	1.55	1.80	2.01	1.55	1.80	1.12	1.12	1.12
Mean ± SD						**1.53 ± 0.49**	**1.34 ± 0.29**	**1.39 ± 0.41**	**1.68 ± 0.43**	**1.45 ± 0.17**	**1.49 ± 0.30**	**1.13 ± 0.01**	**1.13 ± 0.04**	**1.13 ± 0.03**
Abdomen	7	12	160.49	2.5	50.0	**1.02**	**1.04**	**1.02**	**1.09**	**1.10**	**1.09**	**1.08**	**1.10**	**1.10**
Spine	8	13	6.23	16.0	16.0	1.17	1.79	1.33	1.23	1.82	1.41	1.09	1.08	1.09
	9	14	654.48	5.0	25.0	1.05	0.98	1.17	1.35	1.42	1.32	1.24	1.29	1.24
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		17	27.23	5.0	25.0	1.07	1.09	1.05	1.18	1.20	1.16	1.18	1.16	1.17
	12	18	35.6	5.0	25.0	0.95	0.91	0.89	1.06	1.00	0.99	1.11	1.10	1.09
		19	31.69	5.0	25.0	0.95	0.87	0.85	1.06	1.02	1.01	1.13	1.11	1.10
Mean ± SD						**1.05 ± 0.08**	**1.15 ± 0.31**	**1.06 ± 0.17**	**1.17 ± 0.10**	**1.29 ± 0.28**	**1.18 ± 0.15**	**1.15 ± 0.05**	**1.17 ± 0.06**	**1.15 ± 0.04**
Pelvis	13	20	181.98	1.8	5.4	1.12	1.13	1.17	1.19	1.20	1.24	1.12	1.13	1.13
	14	21	196.8	5.0	25.0	1.01	1.04	1.03	1.07	1.10	1.10	1.09	1.09	1.10
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	16	23	88.16	3.0	30.0	1.26	1.12	1.11	1.34	1.19	1.18	1.16	1.17	1.15
Mean ± SD						**1.11 ± 0.11**	**1.10 ± 0.04**	**1.11 ± 0.06**	**1.18 ± 0.12**	**1.17 ± 0.05**	**1.18 ± 0.06**	**1.11 ± 0.04**	**1.13 ± 0.03**	**1.12 ± 0.01**
Overall Mean ± SD						**1.24 ± 0.31**	**1.22 ± 0.25**	**1.20 ± 0.25**	**1.33 ± 0.30**	**1.32 ± 0.23**	**1.29 ± 0.22**	**1.13 ± 0.05**	**1.14 ± 0.05**	**1.13 ± 0.04**

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VMAT-RapidArc vs IMRT en tratamientos de SRS y SBRT

Site	Patient ID	Lesion #	PTV Vol. (cc)	Dose / Fx (Gy)	Total Dose (Gy)	CI_{RTOG}			PCI			HI_{RTOG}		
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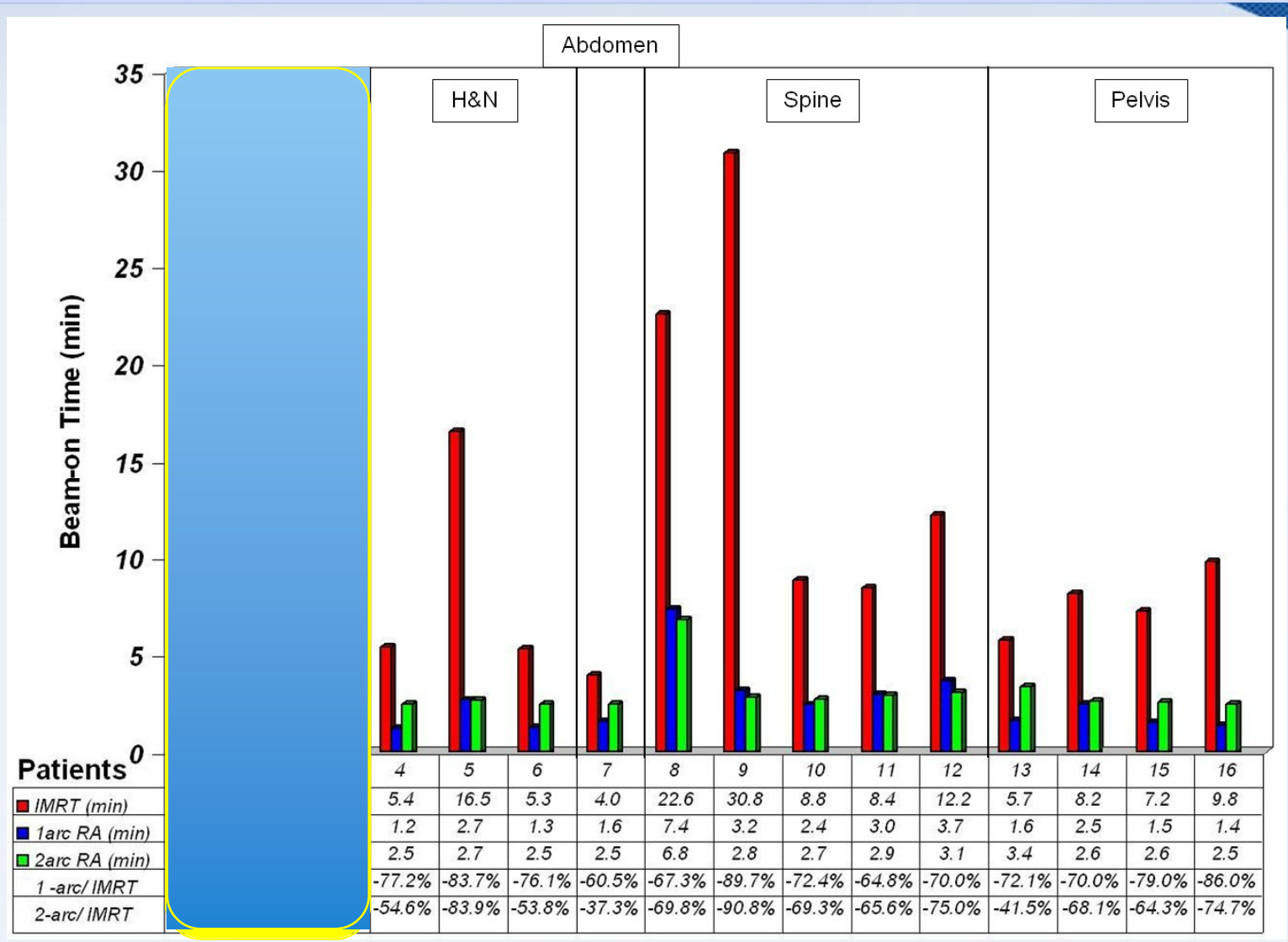
Brain	1	1	2.57	7.0	35.0	1.28	1.16	1.16	1.36	1.23	1.23	1.08	1.11	1.10
		2	20.48	7.0	35.0	1.77	1.46	1.41	1.85	1.61	1.54	1.10	1.18	1.17
		3	15.66	7.0	35.0	1.37	1.37	1.34	1.49	1.49	1.45	1.08	1.13	1.10
	2	4	0.5	6.0	24.0	1.94	1.82	1.84	1.94	1.82	1.84	1.07	1.09	1.08
		5	4.95	6.0	24.0	1.11	1.10	1.16	1.14	1.19	1.22	1.09	1.10	1.10
		6	77.54	6.0	24.0	1.04	1.08	1.07	1.11	1.15	1.14	1.12	1.17	1.12
		7	0.76	6.0	24.0	1.46	1.36	1.41	1.46	1.37	1.42	1.10	1.13	1.12

Site	Patient ID	Lesion #	PTV Vol. (cc)	Dose / Fx (Gy)	Total Dose (Gy)	CI_{RTOG}			PCI			HI_{RTOG}		
						IMRT	1-arc	2-arc	IMRT	1-arc	2-arc	IMRT	1-arc	2-arc
Brain	2	4	0.5	6.0	24.0	1.94	1.82	1.84	1.94	1.82	1.84	1.07	1.09	1.08
		5	4.95	6.0	24.0	1.11	1.10	1.16	1.14	1.19	1.22	1.09	1.10	1.10
		6	77.54	6.0	24.0	1.04	1.08	1.07	1.11	1.15	1.14	1.12	1.17	1.12
		7	0.76	6.0	24.0	1.46	1.36	1.41	1.46	1.37	1.42	1.10	1.13	1.12

VMAT-RapidArc vs IMRT SRS/SBRT: Beam-On Times



Patients	4	5	6	7	8	9	10	11	12	13	14	15	16
IMRT (min)	5.4	16.5	5.3	4.0	22.6	30.8	8.8	8.4	12.2	5.7	8.2	7.2	9.8
1arc RA (min)	1.2	2.7	1.3	1.6	7.4	3.2	2.4	3.0	3.7	1.6	2.5	1.5	1.4
2arc RA (min)	2.5	2.7	2.5	2.5	6.8	2.8	2.7	2.9	3.1	3.4	2.6	2.6	2.5
1 -arc/ IMRT	-77.2%	-83.7%	-76.1%	-60.5%	-67.3%	-89.7%	-72.4%	-64.8%	-70.0%	-72.1%	-70.0%	-79.0%	-86.0%
2-arc/ IMRT	-54.6%	-83.9%	-53.8%	-37.3%	-69.8%	-90.8%	-69.3%	-65.6%	-75.0%	-41.5%	-68.1%	-64.3%	-74.7%

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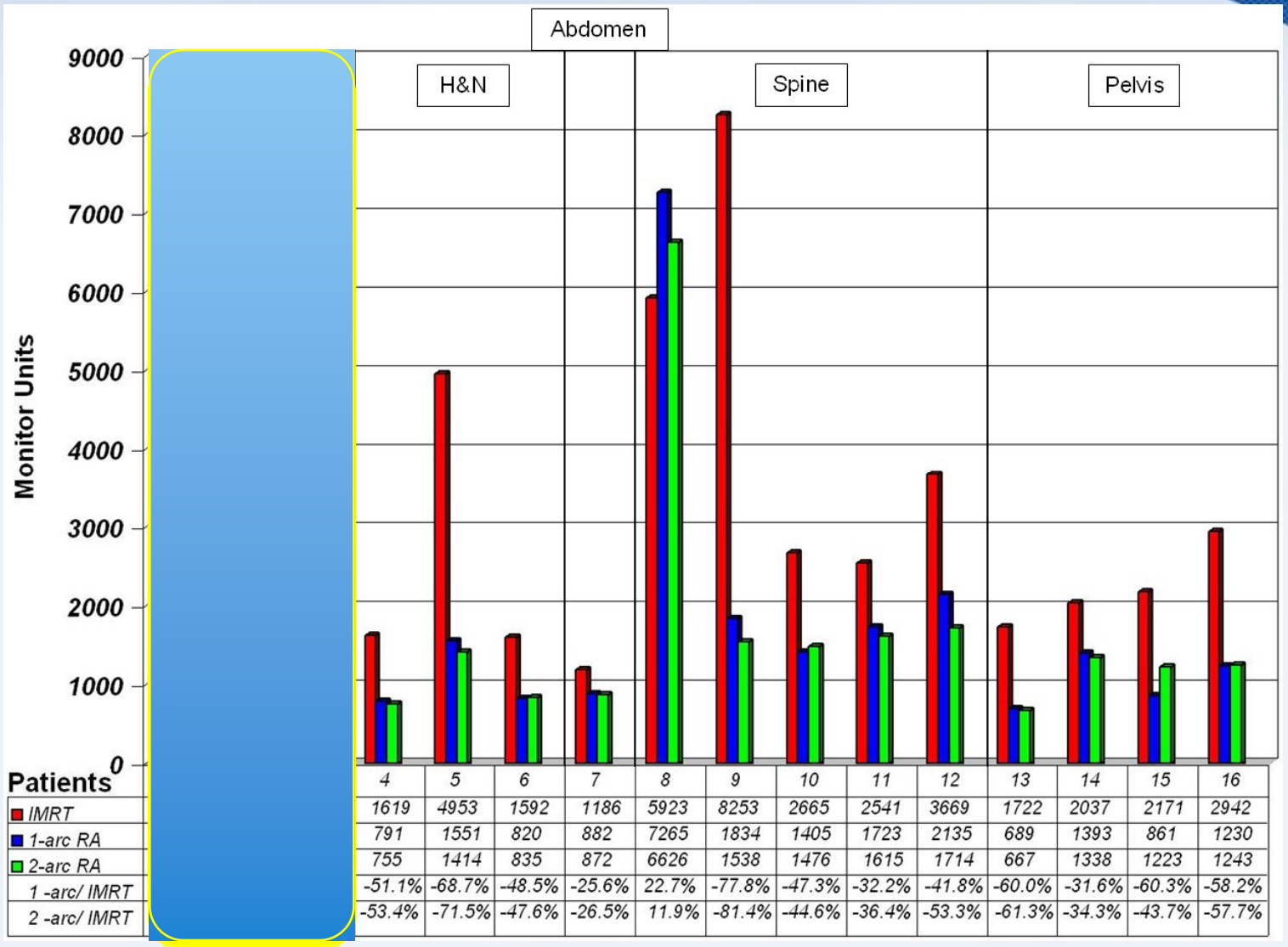
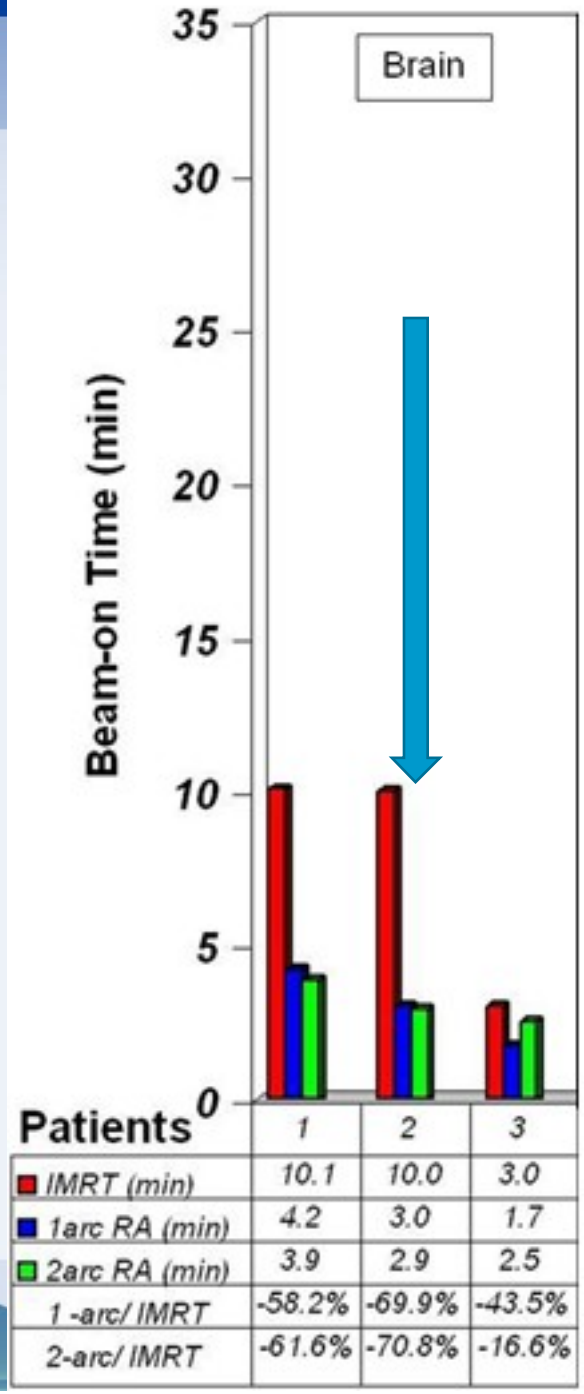
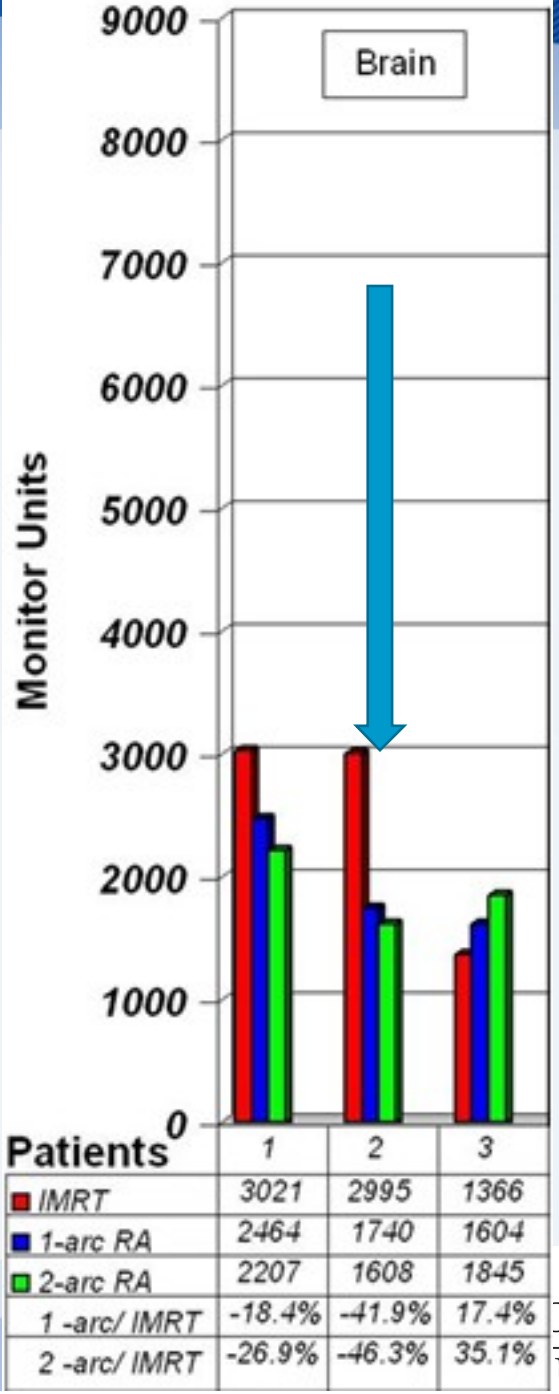
VMAT-RapidArc vs IMRT SRS/SBRT: Monitor Units



Patients	4	5	6	7	8	9	10	11	12	13	14	15	16
IMRT	1619	4953	1592	1186	5923	8253	2665	2541	3669	1722	2037	2171	2942
1-arc RA	791	1551	820	882	7265	1834	1405	1723	2135	689	1393	861	1230
2-arc RA	755	1414	835	872	6626	1538	1476	1615	1714	667	1338	1223	1243
1 -arc/ IMRT	-51.1%	-68.7%	-48.5%	-25.6%	22.7%	-77.8%	-47.3%	-32.2%	-41.8%	-60.0%	-31.6%	-60.3%	-58.2%
2 -arc/ IMRT	-53.4%	-71.5%	-47.6%	-26.5%	11.9%	-81.4%	-44.6%	-36.4%	-53.3%	-61.3%	-34.3%	-43.7%	-57.7%



Patients	1	2	3
IMRT (min)	10.1	10.0	3.0
1arc RA (min)	4.2	3.0	1.7
2arc RA (min)	3.9	2.9	2.5
1 -arc/ IMRT	-58.2%	-69.9%	-43.5%
2-arc/ IMRT	-61.6%	-70.8%	-16.6%



Patients	1	2	3
IMRT	3021	2995	1366
1-arc RA	2464	1740	1604
2-arc RA	2207	1608	1845
1 -arc/ IMRT	-18.4%	-41.9%	17.4%
2 -arc/ IMRT	-26.9%	-46.3%	35.1%

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Conclusiones

1. Paciente tratado con radiacion estereotactica a 4 tumores cerebrales debido a melanoma usando VMAT-RapidArc. Este fue un tratamiento paliativo.

2. Conformidad e Homogeneidad de dosis con VMAT-RapidArc demuestra ser alta calidad basado en los indices de CI_{RTOG} y HI_{RTOG}.

3. Se ha observo una mejora significativa en terminos de tiempo de irradiacion (reduccion en el tiempo de tratamiento).